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New distributional record and bioecology of Invasive Alien predatory stink bug *Perillus bioculatus* (Fabricius, 1765) (Heteroptera: Pentatomidae) from Magadh division

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ABSTRACT

Perillus bioculatus (Fabricius, 1765) is an Invasive alien species (IAS) in India is native of North America, which show color polymorphism and represents four morphs in India. In 2021, during field observation in order to study Invasive Alien Species occurrence and distribution in fauna of Magadh division as a result of subsequent observations we observed a predatory stink bug with polymorphism and predating upon grubs and adults of *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) on parthenium plants. Authors collected some specimens and collected specimens were later identified as a North American origin predator *Perillus bioculatus* (Fabricius, 1765) (Heteroptera: Pentatomidae) by Dr. S. Salini (ICAR – NBAIR). Literature study further revealed that known distribution of *P. bioculatus* is from Uttar Pardesh, Madhya Pardesh and Himachal Pradesh and recently from Nalanda division (Bihar) in India. Now authors reporting the range expansion of newly observed *P. bioculatus* for the first time from Magadh division in Bihar.

Keywords: Two spotted stink bug, Bihar, Invasive Alien Species, Range expansion.

1. INTRODUCTION

Perillus bioculatus (Fabricius, 1765) is a well-known predator of *Zygogramma bicolorata*. *Z. bicolorata* was introduced in India as biocontrol agent of *Parthenium hysterophorus* L. (Heliantheae: Asteraceae). Parthenium is a serious weed and it achieved major weed status in India only within few decades. Now parthenium is very common along with agricultural lands, road edges, grazing land, river banks and flood plains. The adults and larvae of *Z. bicolorata* are capable to feed on Parthenium leaves and flowers. But due to *P. bioculatus* in the natural environmental condition of Himachal Pradesh *Z.*

bicolorata population is not increasing to successfully control Parthenium invasion (Singh et. al., 2017). *P. bioculatus* is native to North America and commonly known as two spotted stink bugs due to a distinct black shape “Y shaped” mark on pronotum and two black spots on prothorax of adult and easy to identify. *P. bioculatus* previously known distribution range Uttar Pradesh (Prasad et. al., 2015), Madhya Pradesh (Chandra et. al., 2019) and Himachal Pradesh only but now the introduction happened in Bihar also. There are four color morphs of *P. bioculatus* occurs in their native range worldwide, in India three color morphs were known far ago and recently fourth color morph has been also reported from Madhya Pradesh (Chandra et. al., 2019).

This the known fact that, the fundamental role of introduction of new IAS in new environmental fauna happen due to accidental transportation or human-mediated deliberation (Russo, 2016). A study on *M. sculpturalis* suggested that the distribution of IAS facilitated by anthropogenic factors like road and maritime traffic are the reason behind intrinsic dispersal ability (Lanner et. al., 2021). Complex introduction and different biotic network for newly introduced species and their new hosts in new environmental fauna pose multiple competition with native species and the current and future establishment or invasion of that introduced IAS is mandatory to predict and manage.

In some cases, intercontinental spread of species happened in very short time and the range expansion is ongoing in introduced area, where the invasion was most recent (Bila Dubail et. al., 2021; Lanner et. al., 2020a). The successful establishment and invasion of some IAS species may be correlated with their social traits and have potential to rapid spread, high population, well established dispersal and in general horrifying competitors (Beggs et. al., 2011; Gesli et. al., 2017; Russo et. al., 2021).

Z. bicolorata was found to defoliate large area of Parthenium in Rajajee National Park situated in Uttarakhand state (Goyal and Brahma 2001). Only *Z. bicolorata* has been proved to be a successful bioagent to manage Parthenium but this alone is not sufficient because the reason that factors affecting to establish sufficient population in natural condition (Kumar, 2017).

2. MATERIAL AND METHODS

During our study *P. bioculatus* collected by extensive and intensive collection-cum-survey tours to cover maximum distribution range in Magadh division using hand picking, net trap and light tarp methods, from various localities. After noticing the occurrence of *P. bioculatus*, we used the host abundance method to point out the affected area by *P. bioculatus*. Collected specimens of stink bugs were photographed and killed in killing jars by pouring ethyl acetate. The photographs and distribution coordinates were taken using GPS essentials in Samsung J Max tablet and represented as a map of distribution in present work. The color polymorphism in nymph and adults is manifested in image (1-18). Nature and level of predation divided in two categories on number of individuals found in 1mtr² in which less than 5 individual 1mtr² taken as low predation cum distribution and more than 10 individual 1mtr² taken as high predation cum distribution. Laboratory rearing of *P. bioculatus* was performed on natural diets. All the reared population of *P. bioculatus* was destroyed safely under laboratory condition to ignore new introduction or unethical dispersal.

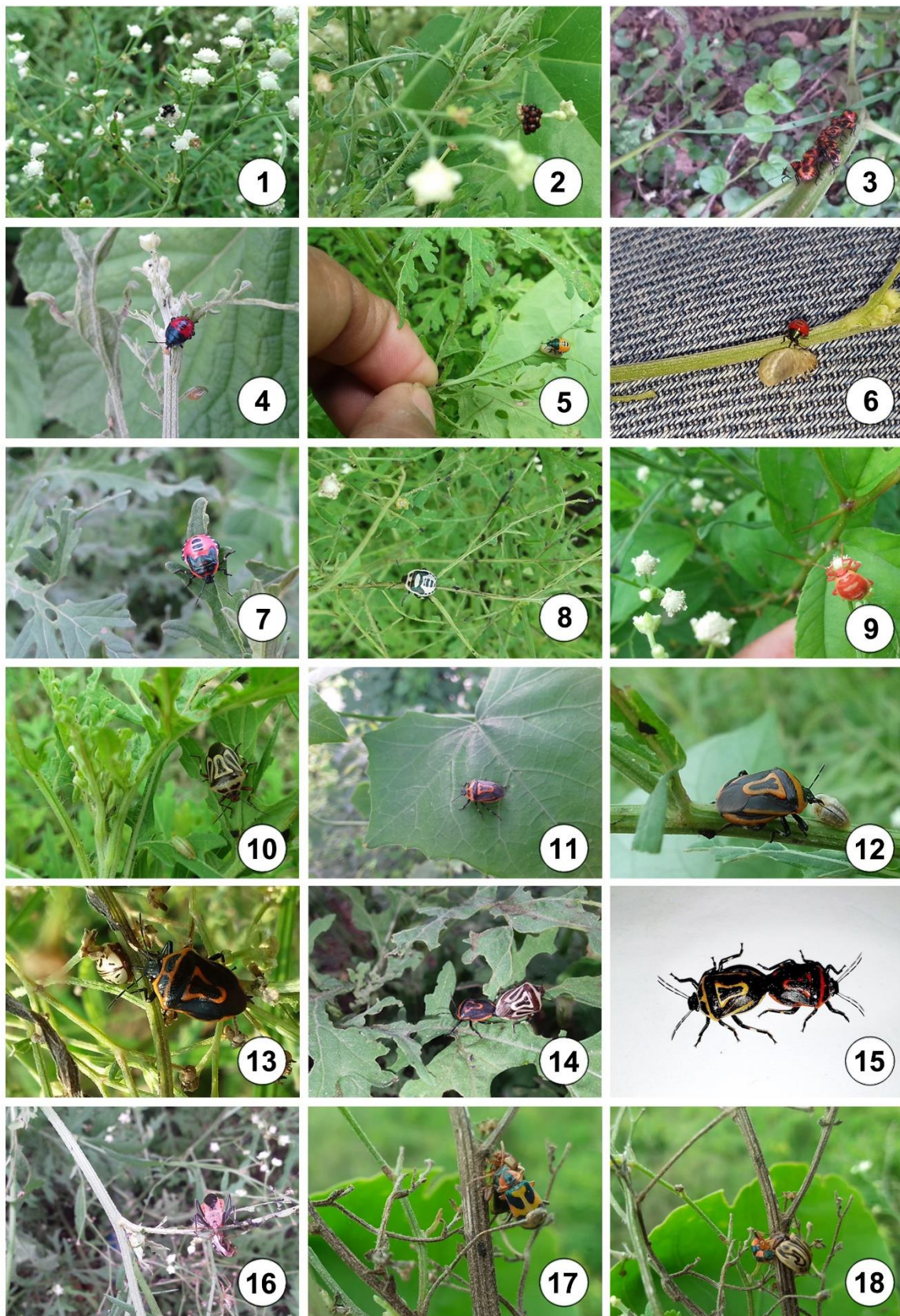
3. RESULT AND DISCUSSION

According to the category divided on the level of predation by *P. bioculatus*; Narhat, Jalalpur, Ibrahimpur, Sheikhpura, Hisua, Bastibigha, Manjhwey, Janbigha, Chakand, Sherghati villages was showing established population in comparison to area Barabar hills, Bela, Makhdumpur, Rajauli and Sirdala villages. The establishment of *P. bioculatus* population performing predation load upon *Z. bicolorata* and it may give rise a new problem.

The *Z. bicolorata* is a well-known limiting bio-agent of parthenium in India. Multiple studies suggested that *Z. bioclorata* successfully reducing the density of parthenium in natural conditions. In India, while *Z. bicolorata* established their population and performing as a satisfactory biocontrol agent of devastating weed like parthenium, occurrence and distribution of *P. bioculatus* will perform a threat on *Z. bicolorata* and help in increase the density of parthenium plants.

The present work makes two main points. First, the occurrence and distribution bionomics of *P. bioculatus* in Magadh division. This distribution meant that *P. bioculatus* will perform extremely negative role in control of parthenium distribution along with *Z. bicolorata* population. Second, we know little about the control measures of *P. bioculatus*. The scarcity of research in the area of IAS should be focused and accurate data should be prepared for future management.

There is an urgent need to expand bio-agent studies to encompass the control measures of *P. bioculatus*. The observation and related information provided in this work will undoubtedly shed light on distribution range of said species in Bihar. Investigating the population, distribution and affected areas will provide us a valuable roadmap to navigate the possible control and impacts on *Z. bicolorata* as well Parthenium control.



Photograph by :- Mohammad Danish Masroor

Figures 1 to 18: 1. Eggs of *P. bioculatus* on flower of Parthenium. 2. Newly hatched nymphs of *P. bioculatus*. 3. Nymphs resting on Parthenium. 4. Nymph of *P. bioculatus* showing orange and metallic blue color morph. 5. Nymph of *P. bioculatus* showing orange and metallic blue color morph. 6. Nymph of *P. bioculatus* showing red and black color morph. 7. Late instar nymph of *P. bioculatus* showing red and blue color morph. 8. Late instar nymph of *P. bioculatus* showing white and black color morph. 9. Nymph of *P. bioculatus* soon after molting. 10. Adult of *P. bioculatus* in white and black color morph. 11. Adult of *P. bioculatus* in red and black color morph. 12. Adult of *P. bioculatus* in yellow and black color morph predating upon grub of *Z. bicolorata*. 13. Adult of *P. bioculatus* predating upon adult of *Z. bicolorata*. 14 & 15. Different color morphs individuals in mating. 16. *Rhynocoris* sp. Predating on the *Z. bicolorata*. 17 & 18. *Spinapalochus fasciatus* scavenging on adult of *Z. bicolorata*.

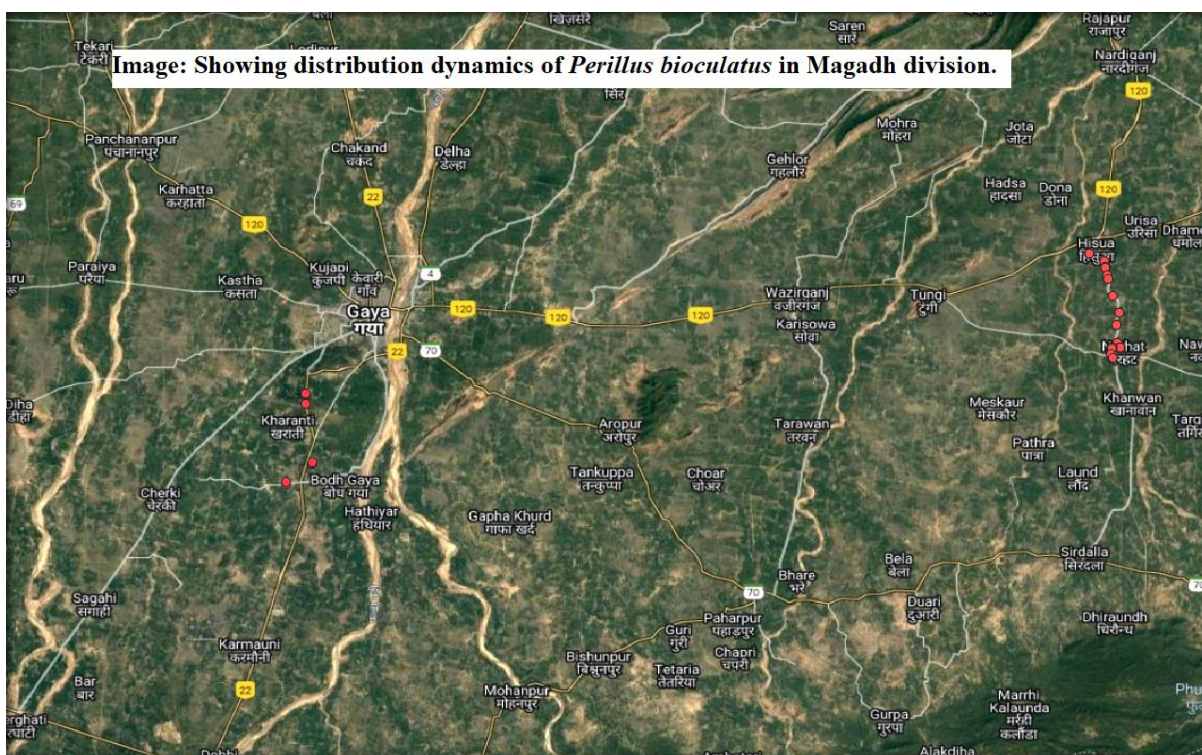
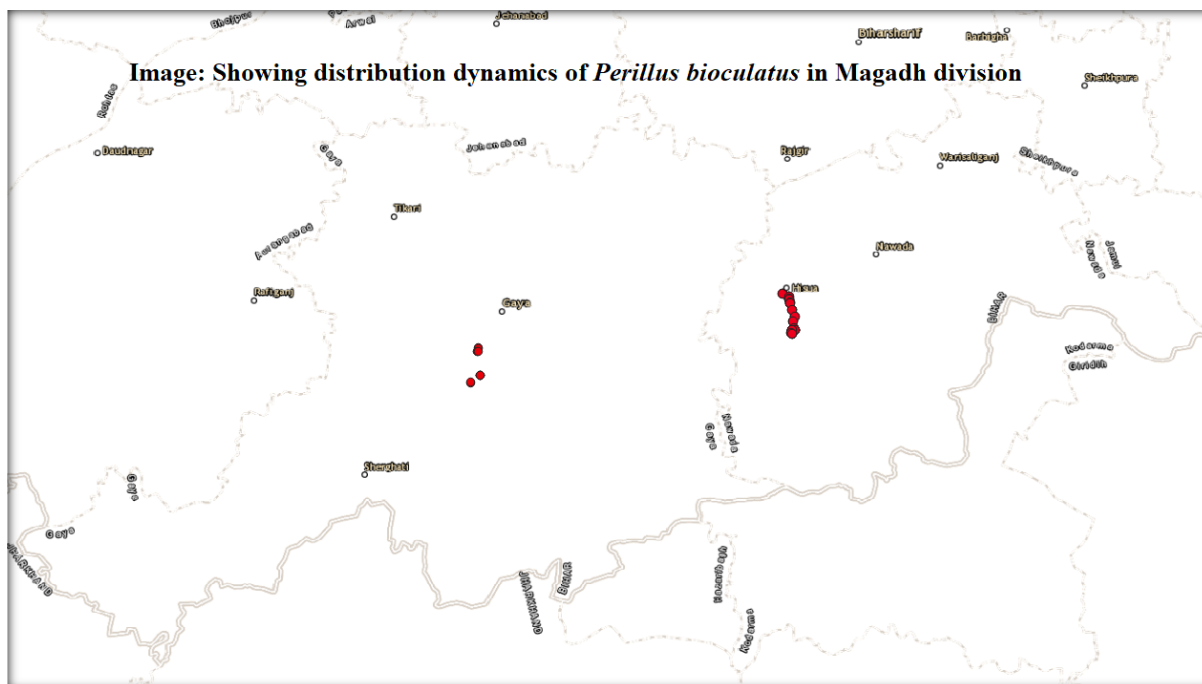


Figure 19 & 20. Map showing distribution dynamics of *P. bioculatus* in Magadh division.

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Authors Contribution

First author and second author done the field survey, taken images and prepared the paper while senior author helped in literature review along with supervision during the survey.

Ethical approval

Perillus bioculatus (Fabricius, 1765) (Heteroptera: Pentatomidae) from Magadh division, India is collected in the study. The ethical guidelines are followed in the study for sample collection & identification. The specimen was collected and identified with the supervision of S. Shalini (Division of Germplasm Collection and Characterization, ICAR – NBAIR, Karnataka, Bangalore).

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Conflicts of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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